

both readily dispersed and less subject to local extinction because of vegetative vigor, early age at first reproduction, and high seed production. They hypothesize a kind of ratcheting effect in which the less variable populations of invaders expand at the expense of the more variable natives.

A specific case of coexistence that continues to intrigue ecologists is the coexistence of sprouting and non-sprouting shrub populations. The basic problem is to explain why the sprouters that hold their ground don't exclude those dependent on seeds. The problem is explored in detail in two chapters. The idea that there are counterbalancing advantages is an obvious general explanation. The Swartboskloof studies both support and refute particular aspects of this theory. Contrary to the expectations of some, Smith et al. failed to find that the two groups of species differed significantly in physiological traits. But they also found that within Swartboskloof the dominance of sprouting species increased with increasing soil moisture. The same mixed bag of affirmations and refutations resulted from comparisons of two species of sprouting and non-sprouting *Protea* species. As predicted from allocation theory (and common sense), the seeder established significantly more seedlings per parent plant. In common with similar chaparral intergeneric comparisons, they found that adult mortality was lower and decreased with age in the sprouter, whereas mortality was higher and tended to increase with age in the seeder. Surprisingly, no differences were found in seedling mortality. Overall though, the importance of catastrophe in explaining coexistence was supported by the conclusion that seeders overcame the greater longevity of the sprouters because of a greater capacity for population expansion after the fire.

The dominance of shrubs on the site is an anomaly that gets considerable attention. With 1500 mm precipitation, tree-dominated vegetation would be expected. Data presented make a convincing case that forest species can establish and grow in fynbos. But forest species are more sensitive to fire and less able exploit post-fire conditions, thus leading to the conclusion that fire is the primary factor preventing a succession toward forest.

This combination of interesting natural history with frequent allusions to data from other regions is a strength of the book. Students of Mediterranean ecosystems in particular will find it of interest. Together with the recently published "Ecology of fynbos" (Oxford University Press, Cape Town, R. M. Cowling, Ed.) we have an excellent summary of current knowledge against which to test the generality of our ideas about the function of Mediterranean-climate shrublands.

Finally I have a mundane but important criticism relevant to resilience, not of ecosystems, but of the book itself. Even before this review was complete page 275 had fallen out of my copy and page 179 clung by less than a cm. We expect our second-hand Barbara Cartland paperbacks to do this, but a new and pricey Springer hardback should be better able to take abuse.

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Note: I have learned that Springer has rebound all remaining copies; therefore books purchased after this review appears should be sound.

The Jepson Manual: Higher Plants of California. By JAMES C. HICKMAN (ed.). 1993. University of California Press, Berkeley. xvii + 1400 pages. ISBN 0-520-08255-9.

With over 5800 vascular plant species growing outside cultivation, California has the most diverse flora of any state—perhaps even any floristic region—in the U.S. Preparing a manual for such a large flora is a monumental task. Making that manual useful not only for professional botanists but for virtually anyone with a serious interest in plants may seem impossible. That, however, is just what the team at the Jepson Herbarium, led by the late Jim Hickman and Larry Heckard, has attempted. They succeeded remarkably well.

The editorial team took several steps to promote the accessibility of the manual. Perhaps the most controversial of these was to strictly limit the technical vocabulary. Though this decision must have caused untold frustration to contributors and editors alike, the reduced jargon is effective and refreshing. The main drawback is an occasional decrease in brevity. A well-written glossary, cross-referenced and extensively illustrated, enables even the novice to use the many specialized terms still required. The glossary would, however, have been better placed immediately before the index or in another easily found place rather than buried in the introductory text.

The extensive use of illustrations is exemplary and further improves the book's accessibility. Nearly every genus is shown, usually by several species that are commonly encountered or show diagnostic or hard-to-describe features. The drawings, executed primarily by Emily Reid and Linda Ann Vorobik, are outstanding. I have found that the illustrations often allow me to forgo confirming my determinations with herbarium specimens. For those without access to herbarium specimens, the illustrations will prove an effective substitute.

Keys can make or break a floristic manual. Nearly all the keys in the *Jepson Manual* are very good. Some are quite innovative, departing in style and content from previously published keys for those taxa. Most striking are the extensive efforts made to key out variable taxa in more than one place. The family key, prepared by David Keil, is particularly notable in this regard, and in allowing for common misinterpretations. It is a joy to use. Even inexperienced botanists will have little difficulty identifying plants to family. Also noteworthy are the keys for several large families, including the Asteraceae and the Poaceae. The key to the former, also a Keil product, is more usable than any others for this family I have seen. I found the key to Poaceae by James P. Smith, Jr., less successful. The second couplet attempts to simplify the problem of interpreting inflorescence structure by asking whether the inflorescence branches are "easily seen at arm's length." This probably is not too bad once one gets over the embarrassment of holding the plant that way. Unfortunately, the key does not allow for many exceptions to or misinterpretations of this early couplet. As a colleague pointed out to me, the abundant weed *Bromus madritensis* var. *rubens*, which usually has an obscurely branched inflorescence, will be very difficult to key to genus. He also noted that many depauperate annual grasses, e.g., several *Bromus* species, have only one spikelet and so will key to *Danthonia unispicata*. In some other keys, attempts at brevity led to awkwardness, for example the first couplet in Scrophulariaceae. Still, the *Jepson Manual* keys are among the best I have used.

Perhaps nothing in a manual stirs more controversy than its taxonomic treatments. With over 200 contributors, considerable variation could be expected. The editors deserve praise for their remarkably successful attempts at imposing uniformity of style. They had less control over content. Some treatments are innovative and reflect extensive work by taxonomic specialists or by experienced botanists whom the editors describe as approaching their work "as taxonomic authors for the first time." Others appear merely to have been taken from Munz's *California Flora* (1959; supplement 1968) and rewritten in the *Jepson Manual* style. Particularly disturbing is the small number of contributors who studied specimens, even from the major California herbaria (*vide* the staff at those institutions). I also found several examples where pertinent literature was overlooked. As a consequence of these problems, many taxonomic treatments—only time will show which—are not definitive.

Despite the great number of contributors, species concepts are almost consistently very conservative, resulting in extensive "lumping" (name changes from Munz's *California Flora* are listed in an appendix). Though nowhere in the book itself can I find a statement of taxonomic philosophy (an unfortunate omission), the contributors' guide directed authors to promote accessibility by ignoring minor variation and hard-to-see characters. That this conservatism was imposed by the editors is further shown by several contributors who have already published papers recognizing taxa they synonymized in the *Manual*. The consequences of this conservative approach for biological conservation are extensively discussed by Skinner and Ertter (*Fremontia*

22(3):23–27, 1993). Taxonomically its consequence should be a healthy stimulus for further research.

Much to the editors' credit, the taxonomic descriptions are remarkably consistent in organization. Many manuals and other taxonomic works have not stressed consistency, causing confusion and frustration. Besides morphology, species descriptions include abbreviated synonymy, chromosome numbers, distribution, toxicity, weediness, and horticultural value. Inclusion of the latter is particularly welcome given the tremendous interest in the use of native plants for drought-tolerant landscaping.

Unlike most manuals that give distribution by political units, the *Jepson Manual* uses biogeographic subdivisions. The 50 units are briefly described in the introduction and nicely mapped (in color) there and again on both inside covers. Almost exclusive use of biogeographic units is generally effective. Sometimes, though, it conveys a broader distribution than is accurate, particularly for narrowly distributed plants that are found in only part of a large unit. For example, *Aralia californica* is stated to be found throughout the California Floristic Province, which extends from northwestern Baja California to southwestern Oregon. *A. californica* actually reaches its southern limit in Orange County. Using biogeographic subdivisions also requires that authors and editors be familiar with the limits of these units throughout the state. Judging by the number of plants limited to the coastal regions of southern California that are reported in the *Manual* to grow in the Peninsular Ranges, this was not always the case. I also found several examples of plants known from the Peninsular Ranges but not listed from there in the *Manual*. Clearly the distributional information should not be taken too literally.

Even experienced botanists will be struck by the extensive use of abbreviations in the keys and descriptions, a consequence of dealing with California's diverse flora in a single volume. Though the abbreviations are nicely explained in a table, it is buried in the *Manual's* introduction. The table should have been reproduced inside one of the covers, and the geographic subdivision map shown only twice.

Discussions of California's geological history (by Jeffrey P. Schaffer) and the evolution of the state's distinctive climate and flora (by Dieter Wilken) provide valuable insights. Both include much recent evidence and are free of outdated community concepts. The introduction also includes a refreshingly unpedantic discussion of the pronunciation of scientific names.

The book has a clean layout and is very pleasing to the eye. Compactness, however, suffered; measuring $21.5 \times 28 \times 5.5$ cm and weighing almost 2.5 kg, the tome stretches the term "field manual." Fortunately given its size and weight, the book seems well made. For a publication of its length and complexity, typographic errors are few and mostly insignificant. At least three will cause confusion, however. On page 23, lead 23 should result in *Swertia* not *Frasera*, which is not recognized in the generic treatment of Gentianaceae. According to David Keil, in his key to the Asteraceae, lead 35 on page 181 should give *Microseris douglasii*, and lead 24 on page 182 should give *Madia*. In addition, Balsaminaceae were left out entirely. The *Jepson Globe*, the newsletter of the Jepson Herbarium (individual subscriptions \$25/yr payable to the Friends of the Jepson Herbarium, mailed to Jepson Herbarium, University of California, Berkeley, CA 94720), will publish errata quarterly and invites input.

Hickman and his team did a remarkably good job of making the complex and diverse California flora accessible. In presentation the *Jepson Manual* represents what a modern flora should be. Though its content may be uneven, it provides new insights into many groups and at the worst should stimulate further research. I recommend the book to anyone, from professional botanist to weekend plant enthusiast, who wants to learn more about California's diverse flora.

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